

CLAIMS

1. A thermal processing method including thermal processing steps having:

- a step of holding a plurality of substrates by means of a substrate holder,

- a step of conveying the substrate holder into a reaction container,

- a step of heating a plurality of zones of thermal process atmosphere in the reaction container by means of a plurality of heating units, respectively, and

- a step of forming thin films on surfaces of the plurality of substrates by introducing a process gas into the reaction container,

- the thermal processing method comprising:

- a first thermal processing step of carrying out the thermal processing steps by using a plurality of first substrates as the plurality of substrates, wherein thin films are formed on surfaces of the plurality of first substrates by means of less consumption of the process gas than on surfaces of production substrates;

- a first measuring step of measuring a thickness of the thin films formed on the surfaces of the plurality of first substrates for each of the plurality of zones of the thermal process atmosphere in the reaction container;

- a first setting step of setting respective temperature set values of the plurality of heating units in such a manner that the thickness measured for each of the plurality of zones substantially coincides with a target thickness of thin films to be formed on the surfaces of production substrates, based on measurement result of the first measuring step;

- a second thermal processing step of carrying out the thermal processing steps by using a plurality of second substrates as the plurality of substrates, wherein thin films are formed on surfaces of the plurality of second substrates by means of more consumption of the process gas than on the surfaces of the plurality of first substrates, and wherein the plurality of heating units are respectively adjusted to the respective temperature set values set by the first setting step;

- a second measuring step of measuring a thickness of the thin films formed on the surfaces of the plurality of second substrates for

each of the plurality of zones of the thermal process atmosphere in the reaction container;

a second correcting step of correcting the respective temperature set values of the plurality of heating units in such a manner that the thickness measured for each of the plurality of zones substantially coincides with the target thickness of thin films to be formed on the surfaces of production substrates, based on measurement result of the second measuring step; and

a third thermal processing step of carrying out the thermal processing steps by using at least a plurality of production substrates as the plurality of substrates, wherein the plurality of heating units are respectively adjusted to the respective temperature set values corrected by the second correcting step.

2. A thermal processing method according to claim 1, wherein the first setting step and the second correcting step are respectively carried out based on a relationship between variation of the temperature set values and variation of the thickness of the thin films, which has been obtained in advance.
3. A thermal processing method according to claim 1 or 2, wherein in the thermal processing steps, the process gas is activated to generate active species, and oxide films are formed on the surfaces of the substrates by means of the active species.
4. A thermal processing method according to claim 3, wherein the process gas comprises a hydrogen gas and an oxygen gas.
5. A thermal processing method according to claim 3 or 4, wherein the first substrates are substrates on which oxide films having an average thickness of 50 nm or more have been formed in advance.
6. A thermal processing method according to any of claims 3 to 5, wherein the second substrates are bare silicon substrates.

7. A thermal processing method according to claim 1 or 2, wherein in the thermal processing steps, the thin films are formed on the surfaces of the substrates by means of a chemical vapor deposition.
8. A thermal processing method according to claim 7, wherein the first substrates are substrates having surfaces on which patterns have not been formed, and the second substrates are substrates having surfaces on which patterns have been formed.
9. A thermal processing method according to any of claims 1 to 8, wherein in the first thermal processing step, the first substrates are fully arranged in a holding region for substrates to be processed in the substrate holder, and in the second thermal processing step, the second substrates are fully arranged in the holding region for substrates to be processed in the substrate holder.
10. A thermal processing method according to claim 9, wherein in the third thermal processing step, the production substrates are arranged at a portion on an upstream side of a flow of the process gas introduced into the reaction container, in the holding region for substrates to be processed in the substrate holder, and the first substrates are arranged at the residual portion in the holding region.
11. A thermal processing method according to claim 10, wherein a pressure in the reaction container, a flow rate of the process gas and a time of the thermal process are common in the second thermal processing step and in the third thermal processing step.
12. A thermal processing unit comprising:
 - a substrate holder that holds a plurality of substrates;
 - a reaction container into which the substrate holder is conveyed;
 - a plurality of heating units that respectively heats a plurality of zones of thermal process atmosphere in the reaction container;

a process-gas introducing unit that introduces a process gas into the reaction container, the process gas serving for forming thin films on surfaces of the plurality of substrates by means of a thermal process,

a temperature setting part that carries out the thermal process to a plurality of first substrates, wherein thin films are formed on surfaces of the plurality of first substrates by means of less consumption of the process gas than on surfaces of production substrates, and that sets respective temperature set values of the plurality of heating units based on thickness of the thin films formed on the surfaces of the plurality of first substrates in such a manner that the thickness measured for each of the plurality of zones substantially coincides with a target thickness of thin films to be formed on the surfaces of production substrates;

a temperature correcting part that carries out the thermal process to a plurality of second substrates in accordance with the respective temperature set values set by the temperature setting part, wherein thin films are formed on surfaces of the plurality of second substrates by means of more consumption of the process gas than on the surfaces of the plurality of first substrates, and that corrects respective temperature set values of the plurality of heating units based on thickness of the thin films formed on the surfaces of the plurality of second substrates in such a manner that the thickness measured for each of the plurality of zones substantially coincides with a target thickness of thin films to be formed on the surfaces of production substrates; and

a production-substrate thermal processing part that carries out the thermal process to at least a plurality of production substrates in accordance with the respective temperature set values corrected by the temperature correcting part.

13. A thermal processing unit according to claim 12, wherein

when the thermal process is carried out to the plurality of first substrates, the first substrates are fully arranged in a holding region for substrates to be processed in the substrate holder, and

when the thermal process is carried out to the plurality of second substrates, the second substrates are fully arranged in the holding

region for substrates to be processed in the substrate holder.

14. A thermal processing unit according to claim 13, further comprising

a substrate-conveying unit that conveys a substrate onto the substrate holder,

wherein the production-substrate thermal processing part is adapted to control the substrate-conveying unit in such a manner that when the thermal process is carried out to at least the plurality of the production substrates, the production substrates are arranged at a portion on an upstream side of a flow of the process gas introduced into the reaction container, in the holding region for substrates to be processed in the substrate holder, and the first substrates are arranged at the residual portion in the holding region.

15. A thermal processing unit according to claim 14, further comprising

the production-substrate thermal processing part has a judging part that judges the number of production substrates.

16. A controlling unit that is used for a thermal processing unit including:

a substrate holder that holds a plurality of substrates;

a reaction container into which the substrate holder is conveyed;

a plurality of heating units that respectively heats a plurality of zones of thermal process atmosphere in the reaction container; and

a process-gas introducing unit that introduces a process gas into the reaction container to form thin films on surfaces of the plurality of substrates;

the controlling unit comprising:

a temperature setting part that carries out the thermal process to a plurality of first substrates, wherein thin films are formed on surfaces of the plurality of first substrates by means of less consumption of the process gas than on surfaces of production substrates, and that sets respective temperature set values of the plurality of heating units based on thickness of the thin films formed on the surfaces of the

plurality of first substrates in such a manner that the thickness measured for each of the plurality of zones substantially coincides with a target thickness of thin films to be formed on the surfaces of production substrates; and

a temperature correcting part that carries out the thermal process to a plurality of second substrates in accordance with the respective temperature set values set by the temperature setting part, wherein thin films are formed on surfaces of the plurality of second substrates by means of more consumption of the process gas than on the surfaces of the plurality of first substrates, and that corrects respective temperature set values of the plurality of heating units based on thickness of the thin films formed on the surfaces of the plurality of second substrates in such a manner that the thickness measured for each of the plurality of zones substantially coincides with a target thickness of thin films to be formed on the surfaces of production substrates.

17. A controlling program that is used for a thermal processing unit including:

- a substrate holder that holds a plurality of substrates;
- a reaction container into which the substrate holder is conveyed;
- a plurality of heating units that respectively heats a plurality of zones of thermal process atmosphere in the reaction container; and
- a process-gas introducing unit that introduces a process gas into the reaction container to form thin films on surfaces of the plurality of substrates;

- the controlling program comprising:

- a temperature setting program that sets respective temperature set values of the plurality of heating units based on thickness of thin films formed on surfaces of a plurality of first substrates by a thermal process carried out to the plurality of first substrates, wherein the thin films are formed on the surfaces of the plurality of first substrates by means of less consumption of the process gas than on surfaces of production substrates, in such a manner that the thickness measured for each of the plurality of zones substantially coincides with a target thickness of thin films to be formed on the surfaces of production

substrates; and

a temperature correcting program that corrects respective temperature set values of the plurality of heating units based on thickness of thin films formed on surfaces of a plurality of second substrates by a thermal process carried out to the plurality of second substrates, wherein the thin films are formed on surfaces of the plurality of second substrates by means of more consumption of the process gas than on the surfaces of the plurality of first substrates, in such a manner that the thickness measured for each of the plurality of zones substantially coincides with a target thickness of thin films to be formed on the surfaces of production substrates.